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(54) **Electrosurgical apparatus**

Elektrochirurgische Vorrichtung

Dispositif électrochirurgical

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Description

[0001] This invention relates to electrosurgical apparatus including circuitry for increasing the radio frequency power applied during surgery and especially during electrosurgical cutting.

[0002] Electrosurgical cutting generally requires a higher output voltage than electrosurgical desiccation. To provide for this, it is known to include within an electrosurgical generator an output transformer which has a higher secondary-to-primary output transformer turns ratio for cutting compared with that used for desiccation. Such increased turns ratio leads to increased demands on the output device driving the transformer, particularly in terms of the peak output current required and power dissipation. To overcome this difficulty, it is known to increase the output impedance of the generator, typically to a value in the range of from 300Ω to 500Ω. This may be achieved by providing a low value coupling capacitor but this has the disadvantage of increased voltage drop across the coupling capacitor when used in high load impedance conditions due to the inherent capacitance of the electrode assembly and any cable coupling the electrode assembly to the generator. In effect, the inherent capacitance represents a capacitive load impedance which produces, with the coupling capacitor, a potential divider reducing the voltage delivered across the load. The problem becomes worse when the electrode assembly is placed in a wet field (e.g. in blood or saline solution), since then the effective load capacitance is increased.

[0003] It is an object of this invention to overcome this disadvantage.

[0004] EP-A-0262888 (Clark) discloses a monopolar electrosurgery system in which the return electrode plate is capacitively coupled to the patient, the potential drop across the capacitance at the operating frequency being compensated for by an in-line inductor in the supply line to the return electrode.

[0005] According to this invention, there is provided electrosurgical apparatus comprising an electrosurgical generator having a generator output coupled to an electrical load which includes an electrosurgical electrode unit and at least one conductor coupling the electrode unit to the generator, characterised in that the generator has a resonant output network determining an operating frequency, in that the resonant output network has an in-line output inductor in series with the coupling conductor, and in that the load is capacitive, the capacitance of the load and the output inductor together forming a series resonant output circuit having a resonant frequency which is higher than the operating frequency of the generator yet is not higher than twice the said operating frequency. Although the load capacitance may be composed entirely of the inherent capacitance between the conductor and the electrode unit and neighbouring conductive elements, it is preferred that it also includes at least one capacitor, i.e. a lumped capacitance, additional to the inherent capacitance, coupled across the output of the generator. As an addition or alternative to the lumped capacitance, a high capacitance cable may be used containing conductors coupling the generator to the electrode unit.

[0006] In one embodiment of the invention, the electrode unit is housed, detachably or non-detachably, in a handpiece which is coupled to output terminals of the generator by a cable. Coupling conductors from the generator output extend through the cable and the handpiece to electrodes on the electrode unit. In this embodiment, the handpiece contains a capacitor coupled across the conductors, thereby to be coupled across the output terminals of the generator when the handpiece is connected. Since handpieces can be supplied with cables of different lengths, the value of the capacitor in any particular handpiece may be chosen at least in part to suit the length of the cable with which it is supplied. Thus, because the inherent capacitance of the conductors in the cable is dependent on the cable length, the capacitor can be selected to yield a required overall or total capacitance value for the combination of the handpiece and cable. Having the capacitor in the handpiece also yields the advantage that, if required, a switch can be provided in the handpiece in series with the capacitor for connecting and disconnecting the capacitor according to the output characteristics required. Indeed, it is possible to include more than one capacitor so that alternative capacitor values can be selected by the user.

[0007] By providing an in-line inductor together with a capacitance across the generator output terminals, and provided that the Q of the resulting series resonant circuit at the operating frequency of the generator is greater than 1, the voltage available across the load, in effect across the capacitance, is higher than achieved in the prior art, even without increasing the number of turns on the secondary winding of the output transformer of a transformer coupled generator output stage. As has already been stated, the resonant frequency of the series resonant combination is preferably higher than the operating frequency of the generator. The preferred range for a given load impedance is 1.25f to 2f where f is the generator frequency at that which maximum power transfer to the load occurs in open loop conditions (i.e. without feedback-controlled modulation which causes output power variation in response to load impedance variation). At the generator frequency, the Q of the series resonant combination may be in the range of from 1.5 to 3.

[0008] With the resonant frequency higher than the generator operating frequency, the series resonant combination is permanently out of tune. This deliberate mismatch has two advantages. Firstly, when the electrode unit is used in a wet field, the increased capacitance results in a lower resonant frequency for the series resonant combination, bringing the resonant frequency closer to the operating frequency of the generator and consequently increasing the voltage delivered to the

load. In this way, the effect of conductive fluid in the region of the electrodes is compensated for by an increase in output voltage beyond that which would otherwise be achieved. Furthermore, the tuning of the series resonant combination is not especially critical since it is used outside its resonant peak impedance, i.e. at points on its impedance versus frequency characteristic where the slope of the characteristic is less steep than nearer the resonant frequency.

[0009] The operating frequency of the generator may be variable according to load impedance at its output. Typically, the operating frequency remains within the range of from 300kHz to 500kHz. The resonant frequency of the series resonant circuit is typically between 450kHz and 700kHz with the preferred frequency in dry conditions being in the range 500kHz to 600kHz. Typical values for the in-line inductor are 150μH to 250μH, with the preferred range being 170μH to 210μH. The total capacitance of the electrode unit, and elements between the electrode unit and the output terminals of the generator, may be arranged so as to be greater than 350pF and preferably greater than 400pF.

[0010] In the case of the electrosurgical generator having a single output for both cutting and desiccation, it is preferable for the in-line inductor to be switched, so that it forms part of the power delivery path through the output stage of the generator when cutting is required, and is switched out or bypassed when a lower voltage output is required, as in desiccation. It is possible to combine the generator within a handpiece which mounts the electrode unit, in which case a simple switch may be provided on the handpiece casing. In the more common situation of the generator being a separate unit connected to a handpiece via a cable, the switch may be provided on the generator housing itself or, preferably, the switching of the inductor may be performed by remote control from a switch on the handpiece. Indeed, the switch may be operated using the same control as a second switch for switching the generator on and off. This may be achieved by including one or more further conductors in the cable between the handpiece and the generator, the handpiece containing two switch elements, each operating a relay in the generator via a transformer-coupled link, for instance. It is possible to operate both switch elements in the handpiece from a single control button so that the surgeon can apply electrosurgical power with a first depression of the button and then, if required, can increase the output voltage for cutting by switching in the in-line inductor with a further depression of the button beyond the depression required for switching the generator on.

[0011] According to a second aspect of the invention, there is provided an electrosurgical generator comprising an output stage having a parallel resonant output circuit forming part of a resonant output network determining an operating frequency of the generator, an output terminal for connection to an electrode unit by means of a coupling conductor, and, connected in series between the resonant output circuit and the terminal, an inductor for forming a series resonant circuit with the capacitance of a capacitive load when connected to the terminal, the series resonant circuit having a resonant frequency higher than the operating frequency, yet not higher than twice the operating frequency.

[0012] The invention will now be described by way of example with reference to the drawings in which:-

Figure 1 is a simplified circuit diagram of electrosurgical apparatus in accordance with the invention;

Figure 2 is a circuit diagram of part of alternative apparatus in accordance with the invention; and

Figure 3 is a graph showing the variation of output power with load impedance.

[0013] A preferred embodiment of the invention is shown in simplified form in Figure 1. Electrosurgical apparatus has a radio frequency electrosurgical generator with an output stage 10 having output terminals 12A, 12B. The generator is preferably of the form disclosed in British Patent No. 2214430, at least insofar as it has a self-tuning output oscillator having a resonant output circuit comprising the secondary winding 14 of an output transformer, a first capacitor 16 coupled in parallel across the secondary winding and a second capacitor 18 coupled in series between the transformer secondary winding and one of the output terminals 12A, 12B of the generator. Accordingly, the resonant frequency of the resonant output circuit is determined in part by the impedance of the load presented to the generator across its terminals 12A, 12B due to the series-connected reactance element represented by the second capacitor 18. The generator has means (not shown) for pulsing the oscillator to regulate the output power. This is achieved by means of a feedback loop. References to open loop conditions in this specification means operation of the generator with that feedback loop disabled.

[0014] The apparatus further includes a bipolar electrode unit 20 having electrodes 20E, the unit being coupled to the generator by power delivery conductors 22A, 22B, each conductor electrically linking a respective electrode to a respective one of the output terminals 12A, 12B of the generator. The conductors 22A, 22B pass from the electrodes 20E through a handpiece 24 which mounts the electrode unit 20, and through a cable 26 joining the handpiece to the generator. It will be noted that in this preferred embodiment, the electrode unit has terminals 20A and 20B allowing detachable electrical connection between the electrode unit 20 and the handpiece 24, and that the handpiece 24 is permanently connected to the cable 26 which, in turn, is detachable from the terminals 12A, 12B of the generator 10. This means that the handpiece and the cable form an assembly which is preferably supplied as a unit.

[0015] In accordance with the invention, the generator

includes an in-line inductor L forming a series element in one of the power delivery paths between the secondary winding 14 of the output stage transformer and one of the conductors 22A, 22B. It will be appreciated that the conductors 22A, 22B have an inherent parallel capacitance, particularly in the cable 26 where they are located close together. This capacitance is shown in Figure 1 as capacitance C_C. Similarly, the electrode unit has an inherent parallel capacitance C_E, which is also shown diagrammatically as a lumped component in Figure 1. Capacitance C_E varies according to the conditions at the electrodes 20E. In a wet field, C_E will be considerably higher than when the unit is dry, due to conductive fluids being in contact with the exposed conductive surfaces of the electrodes 20E. To these inherent capacitances C_C and C_E, there is added a capacitor C_H in the handpiece 24, this capacitance being a capacitor component of predetermined value. The total load capacitance $C_C + C_H + C_E$ forms a series resonant circuit with the in-line inductor L.

[0016] The generator operating frequency varies between about 340kHz and 440kHz without the inductor L in the output circuit. A typical value for inductor L is 175µH. The value of capacitor C_H is chosen so that the resonant frequency of the series resonant circuit is about $1.5f_{gen}$, where f_{gen} is the operating frequency of the generator at which maximum power transfer to the load occurs in open loop conditions with inductor L switched out. (This corresponds in the present case to a load resistance of about 100Ω.) Typically, this gives a value of between 400pF and 500pF for the total load capacitance $C_C + C_H + C_E$ in dry conditions. In practice, the electrode unit in dry conditions has a capacitance of about 20pF with the remainder of the capacitance being split between the handpiece and the cable. C_H is typically in the range of from 150pF to 350pF.

[0017] Capacitor 18 is about an order of magnitude greater than the total load capacitance $C_C + C_H + C_E$. Consequently, the series resonant circuit formed by inductor L and the load capacitance has a relatively minor effect on the operating frequency of the generator 10.

[0018] It will be appreciated that in an embodiment in which the generator is integrated in the handpiece, the inherent capacitance of the conductors 22A, 22B will be considerably less than in the illustrated embodiment. In such a case, the capacitor C_H will be correspondingly large.

[0019] A by-pass switch S is connected across the inductor L to allow it to be switched in or out as required depending on the nature of the electrosurgery being performed.

[0020] The added capacitance which is represented by C_H in the embodiment of Figure 1 need not necessarily be incorporated in the handpiece. In particular it could be incorporated by choosing a cable of suitable length and with a high inherent capacitance, e.g. greater than 100pF or greater even than 200pF per metre.

[0021] While the arrangement shown in Figure 1 results in an increased output voltage across the electrodes 20E when the load impedance is comparatively high (e.g. 1kΩ upwards), a further improvement can be achieved by increasing the number of turns on the secondary winding of the generator transformer as illustrated in Figure 2. Here, the secondary winding is in two portions 14A, 14B, the capacitor 16 being coupled across the larger main portion 14A of the secondary winding only. In this embodiment, portion 14A has twice the number of turns as portion 14B. In-line inductor L is coupled in series between the generator output stage (specifically the secondary winding portion 14B) and one of the output terminals 12A, 12B. In this case, the second capacitor 18 of the resonant circuit, which influences the frequency of the self-tuning oscillator of the generator, is connected between in-line inductor L and output terminal 12A. It will be appreciated that when the in-line inductor is in circuit, the order of connection of the capacitor 18 and inductor L is immaterial. The cable, handpiece, and electrode unit are shown in simplified form with a single load capacitance C_L constituted by the capacitors C_C, C_H, and C_E of Figure 1.

[0022] In this embodiment, the in-line inductor L is switched in and out of the input circuit together with the additional secondary winding 14B by a changeover switch element S_C so that for desiccation, the output terminals 12A, 12B are connected across the main part 14A of the secondary winding only. When a higher output voltage is required, e.g. for electrosurgical cutting, switch element S_C is operated to connect the generator output terminals instead across both secondary winding portions 14A, 14B in combination with the series or in-line inductor L. As before, a series resonant circuit is formed by in-line inductor L and load capacitance C_L, the resonant frequency being higher than the generator operating frequency over the majority, if not all, of the operating frequency range.

[0023] Switch element S_C is preferably the armature and contacts of a changeover relay. For convenience, this relay can be operated remotely by a push button switch (not shown) on the handpiece which, when activated, closes a switch 30 which is connected through a wire 32 in the cable and a connector 12C, to an operating coil 34 in the generator 10. The same push button may be used to operate another switch 36 in the handpiece connected by another wire 38 and another connector 12D to another coil 40 in the generator for switching the generator output on or off.

[0024] The effect of switching in the in-line inductor L in the circuit of Figure 2 is shown in Figure 3, which is a graph plotting the output power delivered to the load as a function of load impedance, the generator output being pulse width modulated to limit the power, in this case, to about 20 watts. The dotted curve shows the power/impedance characteristic with in-line inductor L switched out. This setting would be used for desiccation. The solid line curve shows the effect of switching in the in-line inductor L. It will be noted that the power output

at higher load impedances is substantially increased and, additionally, on a logarithmic scale, the width of the power curve is increased. Both curves have an approximately flat central portion. In these portions, the output power is limited by pulsing the oscillator.

Claims

1. Electrosurgical apparatus comprising an electrosurgical generator having a generator output coupled to an electrical load which includes an electrosurgical electrode unit (20) and at least one conductor (22A) coupling the electrode unit (20) to the generator, characterised in that the generator has a resonant output network (14, 16, 18, L) determining an operating frequency, in that the resonant output network has an in-line output inductor (L) in series with the coupling conductor (22A), and in that the load is capacitive, the capacitance (C_C, C_H, C_E; C_L) of the load and the output inductor (L) together forming a series resonant output circuit having a resonant frequency which is higher than the operating frequency of the generator yet is not higher than twice the said operating frequency.

2. Apparatus according to claim 1, characterised in that the electrical load includes at least one capacitor (C_H) forming a lumped capacitance coupled across the generator output.

3. Apparatus according to claim 2, characterised in that the electrode unit (20) is housed in a handpiece (24) and the capacitor (C_H) is located in the handpiece (24).

4. Apparatus according to claim 3, characterised in that the electrode unit (20) is a bipolar unit having a pair of electrodes (20E) each of which is connected to a respective output terminal (12A, 12B) of the generator by a respective conductor (22A, 22B) passing through the handpiece (24), and in that the capacitor (C_H) is connected between the conductors (22A, 22B).

5. Apparatus according to claim 3 or claim 4, characterised by a switch for connecting and disconnecting the capacitor (C_H).

6. Apparatus according to claim 5, characterised in that the switch is in the handpiece (24).

7. Apparatus according to any preceding claim, characterised in that the said resonant frequency is equal to Kf, K being in the range of from 1.25 to 2 and f being the generator frequency at which maximum power transfer to the load occurs in open loop conditions.

8. Apparatus according to any preceding claim, characterised in that the Q of the series resonant circuit is in the range of from 1.5 to 3.

9. Apparatus according to any preceding claim, characterised in that the operating frequency of the generator is in the range of from 300kHz to 500kHz and the inductor (L) has a value in the range of from 150μH to 250μH.

10. Apparatus according to any preceding claim, characterised in that the generator has a single output for cutting and desiccation and a switch (S;S_C) which is connected such that the inductor (L) forms part of a power delivery path to the load when the switch (S; S_C) is in a cutting mode state, and the inductor (L) is bypassed when the switch (S; S_C) is in a desiccation mode state.

11. An electrosurgical generator comprising an output stage (10) having a parallel resonant output circuit (14,16;14A,16) forming part of a resonant output network determining an operating frequency of the generator, an output terminal (12A) for connection to an electrode unit (20) by means of a coupling conductor (22A), and, connected in series between the resonant output circuit and the terminal, an inductor (L) for forming a series resonant circuit with the capacitance (C_C, C_H, C_E; C_L) of a capacitive load when connected to the terminal, the series resonant circuit having a resonant frequency higher than the operating frequency, yet not higher than twice the operating frequency.

12. A generator according to claim 11, characterised in that the generator is operable at a frequency in the range of from 300kHz to 500kHz and the value of the inductor (L) is in the range of from 150μH to 250μH.

13. A generator according to claim 11 or claim 12, characterised in that the generator includes a mode control for switching between desiccation and cutting modes, the mode control including a switch (S; S_C) which is so connected that in the desiccation mode the inductor (L) is bypassed, and in the cutting mode the inductor is connected in series between the resonant output circuit (10) and the terminal (12A).

14. An electrosurgery system comprising:-

 an electrosurgical generator having a generator output coupled to an electrical load which includes a bipolar electrode unit (20) including a plurality of electrodes (20E) which are connected by respective supply conductors (22A, 22B) to the generator output,
 wherein the generator has a resonant output

network (14, 16, 18, L) having a resonant frequency corresponding substantially to an operating frequency of the generator,
wherein the resonant output network includes an in-line output inductor (1) connected in series with one of the supply conductors (22A, 22B), and
wherein the electrical load including the supply conductors (22A, 22B) and the bipolar electrode unit (20) forms a capacitance (C_C, C_H, C_E, C_L) across the generator output, the capacitance (C_C, C_H, C_E, C_L) forming a series resonant network having a resonant frequency which is higher than the said operating frequency but not higher than twice the operating frequency.

Patentansprüche

1. Elektrochirurgische Vorrichtung, umfassend einen elektrochirurgischen Generator mit einem Generatorausgang, der an eine elektrische Last angekoppelt ist, die eine elektrochirurgische Elektrodeneinheit (20) und mindestens einen die Elektrodeneinheit (20) an den Generator ankoppelnden Leiter (22A) enthält, dadurch gekennzeichnet, dass der Generator ein eine Betriebsfrequenz bestimmende Resonanz-Ausgangsnetz (14, 16, 18, L) aufweist, das Resonanz-Ausgangsnetz eine in Reihe mit dem Koppelleiter (22A) geschaltete In-Line-Ausgangsinduktivität (L) aufweist und die Last kapazitiv ist, wobei die Kapazität (C_C, C_H, C_E; C_L) der Last und die Ausgangsinduktivität (L) zusammen einen Reihen-Resonanzausgangskreis mit einer Resonanzfrequenz bilden, die höher als die Betriebsfrequenz des Generators, aber nicht höher als das Doppelte der Betriebsfrequenz ist.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die elektrische Last mindestens einen Kondensator (C_H) enthält, der eine parallel zum Generatorausgang geschaltete konzentrierte Kapazität bildet.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, dass die Elektrodeneinheit (20) in einer Handeinheit (24) untergebracht ist und der Kondensator (C_H) in der Handeinheit (24) angeordnet ist.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, dass die Elektrodeneinheit (20) eine bipolare Einheit mit einem Paar von Elektroden (20E) ist, die jeweils durch einen jeweiligen, durch die Handeinheit (24) verlaufenden Leiter (22A, 22B) mit einem jeweiligen Ausgangsanschluss (12A, 12B) des Generators verbunden sind, und der Kondensator (C_H) zwischen die Leiter (22A, 22B) geschaltet ist.

5. Vorrichtung nach Anspruch 3 oder 4, gekennzeichnet durch einen Schalter zum Anschließen oder Trennen des Kondensators (C_H).

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, dass sich der Schalter in der Handeinheit (24) befindet.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Resonanzfrequenz gleich Kf ist, wobei K im Bereich von 1,25 bis 2 liegt und f die Generatorfrequenz ist, bei der eine maximale Leistungsübertragung auf die Last bei offener Schleife auftritt.

8. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass das Q des Reihenresonanzkreises im Bereich von 1,5 bis 3 liegt.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Betriebsfrequenz des Generators im Bereich von 300 kHz bis 500 kHz liegt und die Induktivität (L) einen Wert im Bereich von 150 µH bis 250 µH aufweist.

10. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der Generator einen einzigen Ausgang zum Schneiden und zum Austrocknen und einen Schalter (S; S_C) aufweist, der so geschaltet ist, dass die Induktivität (L) einen Teil des Stromzuführungsweges zu der Last bildet, wenn sich der Schalter (S; S_C) in einem Zustand der Schneidebetriebsart befindet, und die Induktivität (L) umgangen wird, wenn sich der Schalter (S; S_C) in dem Zustand einer Austrocknungsbetriebsart befindet.

11. Elektrochirurgischer Generator, umfassend eine Ausgangsstufe (10) mit einem Parallel-Resonanzausgangskreis (14, 16; 14A, 16), der einen Teil eines eine Betriebsfrequenz des Generators bestimmenden Resonanz-Ausgangsnetzes bildet, einen Ausgangsanschluss (12A) zur Verbindung mit einer Elektrodeneinheit (20) mittels eines Koppelleiters (22A) und eine zwischen dem Resonanz-Ausgangskreis und dem Anschluss geschaltete Induktivität (L) zur Bildung eines Reihenresonanzkreises mit der Kapazität (C_C, C_H, C_E; C_L) einer kapazitiven Last, wenn diese mit dem Anschluss verbunden wird, wobei der Reihenresonanzkreis eine Resonanzfrequenz aufweist, die höher als die Betriebsfrequenz, aber nicht höher als das Doppelte der Betriebsfrequenz liegt.

12. Vorrichtung nach Anspruch 11, dadurch gekenn-

zeichnet, dass der Generator mit einer Frequenz im Bereich von 300 kHz bis 500 kHz betreibbar ist und der Wert der Induktivität (L) im Bereich von 150 µH bis 250 µH liegt.

13. Generator nach Anspruch 11 oder 12, dadurch gekennzeichnet, dass der Generator eine Betriebsartensteuerung zum Umschalten zwischen der Austrocknungs- und Schneidebetriebsart enthält, wobei die Betriebsartensteuerung einen Schalter (S; S_C) enthält, der so geschaltet ist, dass die Induktivität (L) in der Austrocknungsbetriebsart umgangen wird und die Induktivität in der Schneidebetriebsart zwischen dem Resonanzausgangskreis (10) und dem Anschluss (12A) in Reihe geschaltet wird.

14. Elektrochirurgisches System, umfassend:

einen elektrochirurgischen Generator mit einem Generatorausgang, der an eine elektrische Last angekoppelt ist, die eine bipolare Elektrodeneinheit (20) mit einer Vielzahl von Elektroden (20E) enthält, die durch jeweilige Versorgungsleitungen (22A, 22B) mit dem Generatorausgang verbunden sind,
wobei der Generator ein Resonanz-Ausgangsnetz (14, 16, 18, L) mit einer Resonanzfrequenz aufweist, die im wesentlichen einer Betriebsfrequenz des Generators entspricht,
wobei das Resonanz-Ausgangsnetz eine In-Line-Ausgangsinduktivität (I) enthält, die mit einem der Versorgungsleiter (22A, 22B) in Reihe geschaltet ist, und
wobei die elektrische Last mit den Versorgungsleitern (22A, 22B) und der bipolaren Elektrodeneinheit (20) eine Kapazität (C_C, C_H, C_E, C_L) parallel zu dem Generatorausgang bildet, wobei die Kapazität (C_C, C_H, C_E, C_L) ein Reihen-Resonanznetz mit einer Resonanzfrequenz bildet, die höher als die Betriebsfrequenz, aber nicht höher als das Doppelte der Betriebsfrequenz liegt.

Revendications

1. Dispositif électrochirurgical comprenant un générateur électrochirurgical ayant une sortie de générateur reliée à une charge électrique qui comprend une unité d'électrode électrochirurgicale (20) et au moins un conducteur (22A) reliant l'unité d'électrode (20) au générateur, caractérisé en ce que le générateur possède un réseau de sortie résonnant (14, 16, 18, L) déterminant une fréquence de mise en oeuvre, en ce que le réseau de sortie résonnant possède une inductance de sortie en ligne (L) en série avec le conducteur de liaison (22A), et en ce que la charge est capacitive, la capacité (C_C, C_H, C_E ; C_L) de la charge et l'inductance de sortie (L) formant ensemble un circuit de sortie résonnant en série ayant une fréquence de résonance qui est supérieure à la fréquence de mise en oeuvre du générateur, encore qu'elle ne soit pas supérieure à deux fois ladite fréquence de mise en oeuvre.

2. Dispositif selon la revendication 1, caractérisé en ce que la charge électrique comprend au moins un condensateur (C_H) formant une capacité localisée reliée aux bornes de la sortie du générateur.

3. Dispositif selon la revendication 2, caractérisé en ce que l'unité d'électrode (20) est logée dans un porte-dispositif (24) et le condensateur (C_H) est situé dans le porte-dispositif (24).

4. Dispositif selon la revendication 3, caractérisé en ce que l'unité d'électrode (20) est une unité bipolaire ayant un couple d'électrodes (20E), chacune d'elles étant reliée à une borne de sortie respective (12A, 12B) du générateur par un conducteur respectif (22A, 22B) passant à travers le porte-dispositif (24), et en ce que le condensateur (C_H) est relié entre les conducteurs (22A, 22B).

5. Dispositif selon la revendication 3 ou la revendication 4, caractérisé par un commutateur pour connecter et déconnecter le condensateur (C_H).

6. Dispositif selon la revendication 5, caractérisé en ce que le commutateur est dans le porte-dispositif (24).

7. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que ladite fréquence de résonance est égale à Kf, K étant dans la plage de 1,25 à 2 et f étant la fréquence de générateur à laquelle un transfert maximal de puissance se produit vers la charge dans des conditions de boucle ouverte.

8. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que la valeur Q du circuit résonnant en série est dans la plage de 1,5 à 3.

9. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que la fréquence de mise en oeuvre du générateur est dans la plage de 300 kHz à 500 kHz et l'inductance (L) a une valeur dans la plage de 150 µH à 250 µH.

10. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que le générateur a une sortie unique pour la découpe et la dessiccation et un commutateur (S ; S_C) qui est relié de sorte que l'inductance (L) forme une partie d'un che-

min d'amenée de courant à la charge lorsque le commutateur (S ; S_C) est dans un état de mode de découpe, et l'inductance (L) est contournée lorsque le commutateur (S ; S_C) est dans un état de mode de dessiccation.

11. Générateur électrochirurgical comprenant un étage de sortie (10) ayant un circuit de sortie résonnant parallèle (14, 16 ; 14A, 16) formant une partie d'un réseau de sortie résonnant, déterminant une fréquence de mise en oeuvre du générateur, une borne de sortie (12A) pour connexion à une unité d'électrode (20) au moyen d'un conducteur de liaison (22A), et, reliée en série entre le circuit de sortie résonnant et la borne, une inductance (L) pour former un circuit résonnant en série avec la capacité (C_C, C_H, C_E ; C_L) d'une charge capacitive quand elle est reliée à la borne, le circuit résonnant en série ayant une fréquence de résonance supérieure à la fréquence de mise en oeuvre du générateur, encore qu'elle ne soit pas supérieure à deux fois la fréquence de mise en oeuvre.

12. Générateur selon la revendication 11, caractérisé en ce que le générateur peut être mis en oeuvre à une fréquence dans la plage de 300 kHz à 500 kHz et la valeur de l'inductance (L) est dans la plage de 150 µH à 250 µH.

13. Générateur selon la revendication 11 ou la revendication 12, caractérisé en ce que le générateur comprend une commande de mode pour commuter entre un mode de dessiccation et un mode de découpe, la commande de mode comprenant un commutateur (S ; S_C) qui est relié de sorte que dans le mode de dessiccation, l'inductance (L) est contournée, et dans le mode de découpe, l'inductance est reliée en série entre le circuit de sortie résonnant (10) et la borne (12A).

14. Système électrochirurgical comprenant :

un générateur électrochirurgical ayant une sortie de générateur reliée à une charge électrique qui comprend une unité d'électrode bipolaire (20) incluant une pluralité d'électrodes (20E) qui sont reliées par des conducteurs d'alimentation respectifs (22A, 22B) à la sortie de générateur,
dans lequel le générateur a un réseau de sortie résonnant (14, 16, 18, L) ayant une fréquence de résonance correspondant sensiblement à une fréquence de mise en oeuvre du générateur,
dans lequel le réseau de sortie résonnant comprend une inductance de sortie en ligne (1) reliée en série avec l'un des conducteurs d'alimentation (22A, 22B), et
dans lequel la charge électrique comprenant les conducteurs d'alimentation (22A, 22B) et l'unité d'électrode bipolaire (20) forme une capacité (C_C, C_H, C_E, C_L) aux bornes de la sortie de générateur, la capacité (C_C, C_H, C_E, C_L) formant un réseau résonnant en série ayant une fréquence de résonance qui est supérieure à ladite fréquence de mise en oeuvre mais non supérieure à deux fois la fréquence de mise en oeuvre.

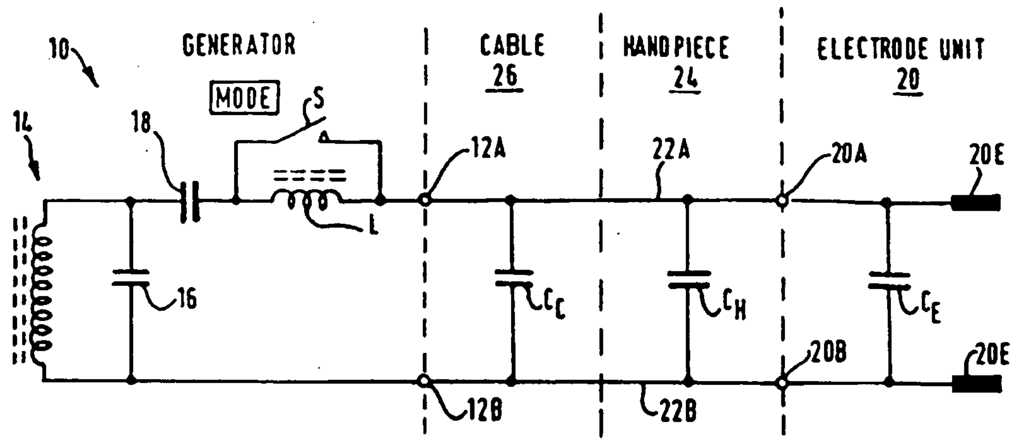

FIG.1.

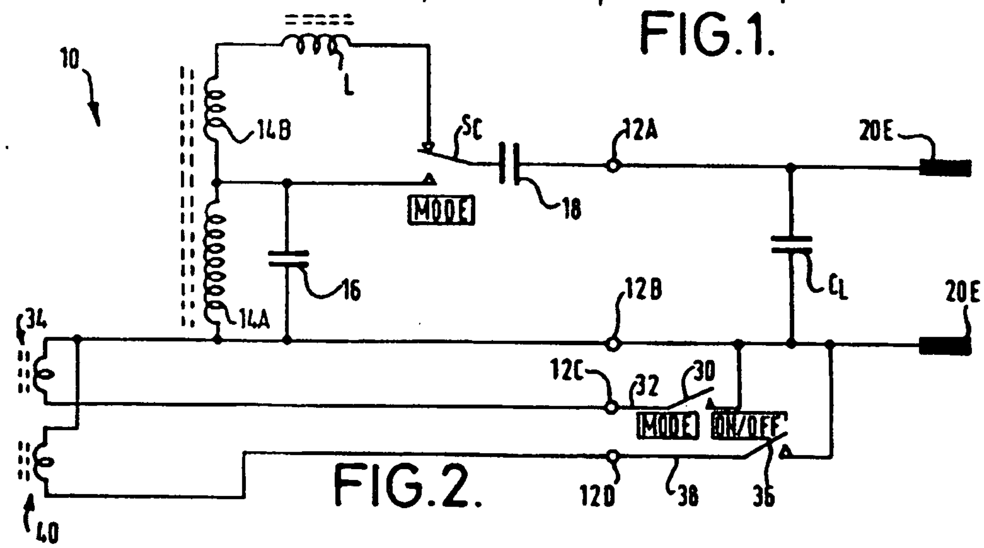

FIG.2.

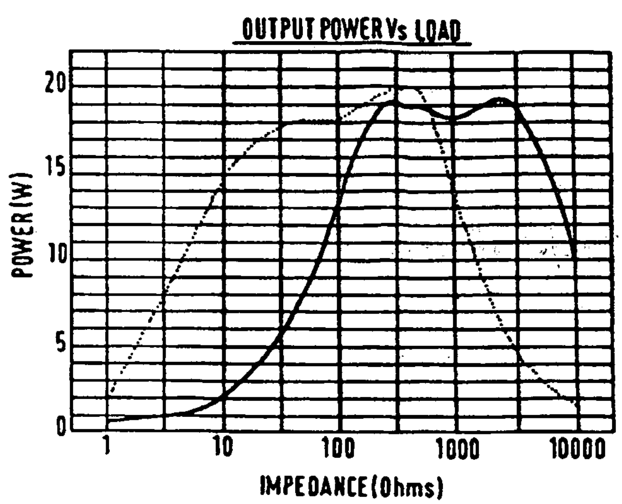

FIG.3.